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Relationship of Exercise to Quality of Life in Cancer Patients Beginning Chemotherapy

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Abstract

Context—Cancer diagnosis and treatment, particularly chemotherapy, has well-established adverse effects on individuals. Exercise has been found to confer benefits to patients, although the current evidence base is limited primarily to patients assessed during or after treatment. Although exercise has been a target of intervention efforts, its relationship to quality of life in patients about to begin chemotherapy has not fully been examined.

Objectives—To examine the relationship of pre-treatment exercise rates to patient quality of life.

Methods—One hundred and ninety-two adults diagnosed with stage I-IV cancer and Eastern Cooperative Oncology Group (ECOG) performance status ≤ 2, provided data on exercise, distress (anxiety and depression), and health-related quality of life prior to their initial chemotherapy infusion.

Results—As predicted, higher rates of exercise activity were associated with lower levels of anxiety and depression, and better overall mental and physical quality of life. These relationships were independent of demographic variables (i.e., body mass index and age) also associated with quality of life in the present analyses.

Conclusions—These findings further highlight the importance of assessing exercise before the start of chemotherapy as part of broader efforts to link patients to appropriate interventions aimed at enhancing quality of life. Findings also raise the possibility that assessing exercise rates could be useful in matching patients to the type of intervention most likely to benefit them. Future research should use prospective longitudinal designs to further explore this association.

Keywords

Cancer; oncology; exercise; activity level; depression; anxiety

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Introduction

A large body of evidence has documented the adverse mental impact for many individuals of a cancer diagnosis and the adverse mental and physical impact of many forms of cancer treatment.[1-6] Chemotherapy, in particular, often precipitates or exacerbates symptoms such as fatigue,[7] nausea/vomiting,[8-10] and emotional distress,[4, 7, 11-14] with associated declines in well-being and functioning. Consequently, it is important to identify ways to prevent or relieve these symptoms and to improve their impact on quality of life. Exercise is an important health behavior that confers numerous positive benefits to those who engage in it regularly.[15] A growing body of observational and interventional research suggests that exercise also has the potential to improve mood and quality of life and reduce fatigue in cancer patients. [7, 16-19]

Cancer and its treatment can present significant challenges to participation in exercise regimens.[20] Despite evidence that exercise is beneficial, less than half of patients are engaged in some form of it during cancer treatment, with estimates ranging from 15-44% of patients.[21-23] Findings indicate that rates of exercise decrease during the course of active treatment.[24-26] Among breast cancer patients, greater declines have been reported for patients treated with chemotherapy, as compared to surgery alone and surgery combined with radiotherapy.[27] Thus, compared to other forms of cancer treatment (e.g., surgery and radiotherapy), chemotherapy appears to have a greater negative impact on exercise as well as overall rates of daily activity.

Although it may be a challenge for patients, evidence from randomized trials suggests that initiating exercise during chemotherapy treatment is both feasible and beneficial.[16, 28, 29] Along these lines, studies of exercise during chemotherapy have reported adherence rates ranging from 20% to 98% for supervised exercise training and 51% to 90% for home-based exercise training.[17-19] Moreover, randomized, controlled trials (RCTs) have shown that, relative to chemotherapy patients in control conditions, chemotherapy patients participating in exercise programs experience less emotional distress,[22, 31, 32] and better overall mental[32, 33] and physical[22,34] quality of life. Results from RCTs also indicate that patients participating in exercise interventions experience less fatigue post-treatment; [30, 31] results regarding benefits on fatigue during treatment have been mixed.[16]

The potential for patients to benefit from exercise during chemotherapy suggests the importance of gaining information about exercise in the period immediately before the start of chemotherapy. Identification of recent exercise patterns and factors associated with pretreatment exercise activity could be used to tailor interventions designed to promote exercise during chemotherapy treatment. For example, interventions to promote adoption of exercise in sedentary patients may differ greatly from those to promote exercise maintenance in patients who routinely engage in physical activity. As such, knowledge of patients' pre-chemotherapy exercise status is critical. In addition, developing a profile of demographic, clinical, and psychosocial characteristics of patients not regularly exercising before the start of chemotherapy would be extremely helpful for planning exercise interventions targeted to these individuals. Most existing studies have not directly addressed this issue, since they rely on retrospective reports of exercise prior to cancer diagnosis[24, 35] or current reports of exercise after the start of chemotherapy.[36, 37] One of few pieces of relevant evidence comes from a study by Demark-Wahnefried et al.[26] in which women provided self-reports of physical activity before and after the start of adjuvant chemotherapy. In addition to reporting an average level of physical activity before the start of treatment (2159 kJ/d ± 490), the study found that physical activity declined significantly after the start of treatment.[26]

The current study sought to address this gap in knowledge by assessing recent exercise activity and examining the links between exercise activity and quality of life in cancer patients scheduled to undergo chemotherapy. Based on findings among cancer survivors and associations between exercise and quality of life for cancer survivors (post-treatment), it was hypothesized that higher rates of pre-treatment exercise would be associated with less depression and anxiety and better health-related quality of life. The study also explored the relationship of recent exercise activity to patients' demographic characteristics (e.g., age, gender) and clinical characteristics (e.g., cancer type and stage).

Methods

Participants

Participants were recruited as part of a larger study investigating the efficacy of interventions (i.e., stress management and exercise training) designed to improve quality of life during chemotherapy treatment. Eligibility criteria for the study were that participants: 1) have a cancer diagnosis; 2) be at least ≥ 18 years of age; 3) have not received intravenous chemotherapy within the past two months; 4) be scheduled to receive cytotoxic chemotherapy as an outpatient at Moffitt Cancer Center (MCC) over a period of at least nine weeks; 5) have no contraindications to participating in moderate intensity exercise or graded exercise testing as determined by their attending oncologist and research staff; 6) be capable of speaking and reading English; 7) provide written informed consent, and 8) have an Eastern Cooperative Oncology Group (ECOG) performance status of ≤ 2. Patients with ECOG score > 2 (or 3+) are either capable of only limited self-care, or confined to bed or chair more than 50% of waking hours, indicating that patients require assistance/support; this precluded safely participating in the walking exercise program in the current study.

Of the 236 patients who were eligible and approached, 192 (81%) agreed to participate. The 44 patients who did not agree to participate cited lack of time as the reason for study refusal. In preliminary analyses comparing non-participants to study participants, no differences were found. That is, participation was not associated with age, gender, marital status, cancer diagnosis, cancer stage, or ECOG status (*P*s > 0.05).

Procedure

At MCC, patients being considered for chemotherapy are seen in consultation by a medical oncologist. Those for whom chemotherapy is indicated are then scheduled to receive their initial infusion at a later date. Patients being seen for consultations were identified through the use of an existing computerized appointment system. Patient eligibility was initially determined via a medical chart review. Final determination was based on the medical oncologist reviewing and signing a clearance form that excluded patients for whom moderate exercise or graded exercise testing was contraindicated. Those patients meeting eligibility criteria were introduced to the study by a research assistant and provided with an opportunity to ask questions before signing an Institutional Review Board-approved informed consent form. Following screening and consent procedures and before randomization to intervention condition, participants completed questionnaires, which are the focus of this report. Participants were asked to complete the paper-and-pencil questionnaires during the appointment immediately prior to beginning chemotherapy treatment.

Measures

Demographic and Clinical Characteristics—Demographic information was obtained through the use of a standardized self-report questionnaire. Variables assessed were age, gender, race/ethnicity, educational attainment, marital status, and body mass index (BMI).

Clinical information, comprising cancer type, cancer stage, ECOG performance status, time prior to treatment (lag time in days between completion of baseline questionnaires and chemotherapy initiation), recent cancer surgery, and previous treatment with chemotherapy, was obtained through review of patients' medical charts.

Rates of Leisure Exercise—The Leisure Score Index of the Godin Leisure-Time Exercise Questionnaire (LSI) was used to assess current exercise activity.[38] The LSI consists of questions that assess the average frequency of mild, moderate, and strenuous exercise in the past week.[39]The LSI yields a standard score of estimated weekly metabolic equivalent tasks (METS).[38] The reliability and validity of the LSI has been found to compare favorably with other self-report measures of exercise activities in terms of test-retest scores and correlations with objective activity monitors and objective fitness indices.[40] In addition to calculating average weekly METS, participants were grouped according to their highest level of exercise intensity in the past week as reported on the LSI to provide another index of exercise activity. Participants who reported engaging in no exercise in the past week constituted the "no exercise group." Participants who reported engaging in mild intensity exercise only as their highest level of exercise activity in the past week constituted the "mild exercise group." Participants who reported engaging in any moderate or strenuous exercise in the past week constituted the "moderate or strenuous exercise group." Both METS and exercise group were included in the descriptive and correlational analyses. METS as a continuous variable was included in the hierarchical analyses.

Health-Related Quality of Life—The Acute (past week) Version of the Medical Outcomes Survey 36-Item Short Form (SF-36) was used to assess perceived health and functioning.[41, 42]This self-report instrument contains eight multi-item scales: general health perceptions, physical functioning, role limitations because of physical problems, bodily pain, general mental health, vitality, role limitations because of emotional problems, and social functioning. The SF-36 also yields two summary scores that reflect the two-dimensional factor structure underlying the eight subscales: a physical component summary score (PCS) and a mental component summary score (MCS). Three scales, physical functioning (PF), role-physical (R-P), and bodily pain (BP), load positively only on the physical component summary.[42] Three other scales, mental health (MH), social functioning (SF), and role-emotional (R-E) load positively only on the mental component summary.[42] The remaining two scales, vitality (VT) and general health (GH), load positively on both components.[42] Reliability (alpha) coefficients for the SF-36 scales in the present study ranged from 0.73 (general health) to 0 Eastern Cooperative Oncology Group 0.91 (vitality and physical functioning).

Depression—The Center for Epidemiological Studies Depression Scale (CES-D) is a self-report measure of depression severity in the past week.[43] The 20 items are scored on a 4-point scale (0= <1 day to 3= 5-7 days). The reliability and validity of this measure have been demonstrated in a variety of clinical populations, including cancer patients.[44] Reliability (alpha) of the CES-D for the present study was 0.88.

Anxiety—The Beck Anxiety Inventory (BAI) is a self-report measure that assesses the severity of anxiety symptoms in the past week.[45] The reliability and validity of the BAI have been demonstrated in a variety of clinical populations, including cancer patients.[45] Reliability (alpha) of the BAI in the present study was 0.90.

Statistical Analyses

Univariate correlational analyses were conducted to examine the relationships of clinical and demographic characteristics with exercise, anxiety, depression, and quality of life, and

relationships of exercise with anxiety, depression, and quality of life. Demographic or clinical characteristics found to be significantly ($P < 0.05$) related to anxiety, depression, and quality of life were utilized as control variables in subsequent hierarchical regression analyses further examining the relationship of exercise (MET scores) to anxiety, depression, and quality of life. Additional analyses were conducted that excluded from the sample any participant who had previously received chemotherapy. As the exclusion of these participants (n=33) did not significantly change the direction nor strength of the results, this data is included in the final analyses.

Results

Demographic, Clinical, and Study Variable Characteristics

The demographic and clinical characteristics of the sample are shown in Table 1. Participants were primarily female (67%), Caucasian (93%), well-educated (40% held a college degree), married (61%), and diagnosed with either breast (40%) or lung cancer (31%). The majority of participants had stage III (30%) or stage IV (33%) disease. Of the 63 participants with stage IV disease, 41 had a diagnosis of lung cancer. Of the remaining 22 participants, the most common disease site was the gastrointestinal tract (n=8 patients with gastric, colon, or rectal cancer). Among the 33 participants who had undergone previous chemotherapy, three patients had received it in the past year, and 30 had received it between one year and 23 years ago. For those who had undergone previous radiotherapy, six patients received it within the past 12 months, and seven had received it from one year to 45 years ago. The means and ranges for exercise, anxiety, depression, and quality of life variables are shown in Table 2.

Relationship of Demographic and Clinical Variables to Study Variables

Correlational analyses were performed to examine the relationship of demographic and clinical variables with anxiety, depression, quality of life, and exercise. As shown in Table 3, several significant ($P < 0.05$) relationships were observed. Younger age and higher BMI scores were associated with higher levels of anxiety. Higher BMI scores, alone among the demographic and clinical variables, were associated with higher levels of depression. Gender (being female) and younger age were associated with better physical quality of life. Additionally, less advanced cancer stage, lower ECOG status (indicating better physical functioning), and being novel to (i.e., not previously treated with) chemotherapy were significantly associated with better physical quality of life. However, mental quality of life was not significantly correlated with any sociodemographic or clinical variables. Greater physical functioning (lower ECOG performance status) and more time prior to treatment were associated with greater rates of exercise (in weekly METS).

Relationship of Exercise to Anxiety, Depression, and Quality of Life

Correlations between exercise and anxiety, depression, and quality of life are shown in Table 4. As expected, findings indicated that a higher METS score was related to a lower score on the BAI ($P < 0.01$) and the CES-D ($P < 0.05$). That is, higher rates of exercise activity were associated with lower levels of anxiety and depression. A similar pattern of results was observed between METS scores and the component summary scales and individual scales of the SF-36. Again, as expected, higher rates of exercise activity were significantly ($P < 0.01$) related to better overall mental and physical quality of life, better general health, better physical role, and social functioning, greater vitality, and less bodily pain. With the exception of anxiety, the exercise group variable displayed a similar pattern of significant relationships. Given the similarity of results for both exercise variables, only METS scores (as a continuous variable) were used in hierarchical regression analyses. Given

that all subscales of the SF-36 were significantly correlated to METS, the component scores (MCS, PCS) will be used in hierarchical regression analyses.

Hierarchical Analyses Controlling for Relevant Demographic and Clinical Variables

Additional analyses were undertaken to determine if the observed relationships of exercise activity with anxiety, depression, and health-related quality of life were independent of any associations of demographic or clinical factors with these outcomes. Toward that end, a series of hierarchical regression analyses of these outcomes were conducted in which clinical or demographic variables significantly associated with anxiety, depression, or mental or physical quality of life were entered first into regression equations followed by exercise activity (i.e., METS scores). As the two component scores and all eight subscales of the SF-36 were significantly correlated with exercise and METS (displayed in Table 4), the MCS and PCS were included as outcomes in the analyses.

Table 5 summarizes the results for anxiety. In step 1, age and BMI accounted for 5% of the variance in anxiety ($P = 0.01$). After controlling for age and BMI, exercise activity accounted for an additional 3% of the variance in anxiety ($P = 0.01$).

Table 6 illustrates the results for depression. In step 1, BMI accounted for 3% of the variance ($P = 0.02$). After controlling for BMI, exercise activity accounted for an additional 3% of the variance in depression ($P = 0.02$).

Table 7 summarizes the results for physical quality of life. In step 1, age, gender, cancer stage, ECOG score, and previous chemotherapy treatment accounted for 13% of the variance ($P < 0.001$). After controlling for covariates, exercise activity accounted for an additional 10% of the variance in physical quality of life ($P < 0.001$).

A regression equation was not performed for mental quality of life because no clinical or demographic variable was significantly associated with this outcome. Correlations presented previously in Table 4 indicate that exercise activity accounted for 5% of the variance in mental quality of life.

Discussion

The current study was designed to fill the general gap in knowledge about exercise activity before the start of chemotherapy treatment. In a sample of patients about to start chemotherapy, we found that 33% reported engaging in no exercise in the past week. Among the 67% who reported exercising in the past week, 43% had engaged in mild exercise and 57% had engaged in moderate or strenuous exercise. As hypothesized, higher rates of exercise were associated with lower levels of anxiety and depression, and better overall physical and mental quality of life. Furthermore, exercise rates were associated with pre-chemotherapy levels of anxiety, depression, and overall mental and physical quality of life over and above the effects of demographic variables also found to be related to these outcomes (i.e., age and BMI).

In prior research, exercise has been associated with better quality of life and psychological well-being for patients undergoing treatment and during the survivorship period.[15,16] Findings from the present study suggest that the benefits from exercise may extend into to the pre-chemotherapy treatment period. Current findings are also consistent with research on the benefits of exercise for individuals with other medical conditions such as Type 2 diabetes[46] and cardiovascular disease.[47]

In the present study, exercise activity was not related to demographic variables (e.g., age) nor to clinical variables such as BMI or previous chemotherapy exposure. These findings are contrary to previous findings based primarily on early stage breast cancer patients assessed during and after treatment.[21, 48, 49] The inclusion of patients with later stage disease in the current study may have attenuated the association between exercise activity and BMI. That is, patients with advanced disease and a previously high BMI may have lost significant weight as a result of their disease. Additionally, most of the patients (30 of 33) with prior exposure to chemotherapy had received it more than one year ago, and in many of these instances, several years (up to 24 years) previously. The considerable time since previous treatment masked potential links between prior chemotherapy exposure and exercise. Among clinical variables, exercise activity was related to ECOG performance status, although not to cancer stage or recent cancer surgery. As ECOG status is a proxy for physical functioning, this likely reflects an overlap in conceptualization. Specifically, if one is more physically able, one would be more likely to exercise.

The strengths of the current study include a sample of patients heterogeneous with regard to both cancer diagnoses and cancer stage. As noted previously, most previous studies have focused on women with breast cancer and on patients with early stage disease. In addition, the current study is one of few to examine exercise and its correlates in the important period just before the start of chemotherapy treatment. Nevertheless, the current study is not without its limitations. Despite heterogeneity in clinical factors such as cancer stage and diagnosis, the sample was relatively homogeneous in that a large majority of participants were white, female, married, and not living in poverty. Second, average ECOG performance status was relatively high in this sample since it was drawn from a larger study investigating the efficacy of exercise and stress management interventions for chemotherapy patients. Third, given the lack of longitudinal data, no firm conclusions can be drawn regarding the direction of causality. While it is likely that greater rates of exercise resulted in better quality of life and less anxiety and depression, we cannot rule out the possibility that less pre-chemotherapy distress and better quality of life resulted in higher exercise rates. Fourth, it is possible that there are factors affecting pre-chemotherapy exercise rates that were not assessed, such as prior advice given by their medical team about whether or not to exercise after cancer diagnosis.

Several future directions are suggested by the results of the current study. Explication of factors associated with pre-chemotherapy exercise participation (why patients are/are not exercising) is needed, which may include barriers to exercise or motivation or knowledge deficits. For example, are patients not exercising before initiating chemotherapy because they believe their oncologist either does not recommend it or feels they are not physically able to exercise (i.e., that exercise might incur deleterious consequences for their health)? Studies should also be conducted examining changes in exercise rates from diagnosis through the beginning of treatment. Intentions to exercise during the course of treatment should also be assessed. Additional research is needed to identify the optimal frequency, intensity and duration of exercise for improving quality of life in cancer patients undergoing chemotherapy. Knowledge of these factors, in conjunction with the correlates of pre-chemotherapy exercise identified in the present study, will be useful in planning intervention efforts aimed at increasing exercise participation among cancer patients beginning treatment and ultimately, improving quality of life for this population.

In summary, the ability to identify factors that amplify or attenuate risk of distress and dysfunction is important, especially factors that are modifiable and can be targeted for intervention. The present study examined these relationships just before the start of chemotherapy, a period that has received little attention in exercise research. Findings indicate that there was considerable variability in exercise activity among patients about to

start chemotherapy and consistently indicated that greater exercise activity was associated with better physical and mental well-being and less psychological distress. Overall, these findings lend support to efforts to promote exercise activity among patients about to start chemotherapy and can serve those efforts by identifying patients' recent exercise activity.

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Table 1

Demographic and Clinical Characteristics

Demographic Variable	Mean (SD) / Range	*n*	Percentage
Age	56.4(10.8) / 29-81 years	192	---
Body Mass Index (BMI)	26.9 (5.2)	192	---
Gender	Female	130	67.7
	Male	62	32.3
Ethnicity	Non-Hispanic	175	91.1
	Hispanic	17	8.9
Race	Caucasian/White	178	92.7
	African American/Black	5	2.6
	> 1 race	4	2.1
	Asian	3	1.6
	Native American	2	1.0
Education	College degree	76	39.5
	HS diploma	106	55.2
	< HS diploma	10	5.3
Marital Status	Not married	75	39.1
	Married	117	60.9
Clinical Variable			
Cancer Diagnosis	Breast	77	40.2
	Lung	60	31.3
	Ovarian	12	6.2
	Colorectal	12	6.2
	Bladder	6	3.1
	Prostate	6	3.1
	Other Sites ($n < 6$)	19	9.9
Cancer Stage	I	22	11.5
	II	50	26.1
	III	57	29.6
	IV	63	32.8
ECOG Status	0	130	67.7
	1	62	32.3
	2	0	0.0
Previous Chemotherapy Treatment	No	159	82.8
	Yes	33	17.2
Previous Radiotherapy Treatment	No	179	93.2
	Yes	13	6.8
Recent Cancer Surgery	No	60	31.3
	Yes	132	68.7

Demographic Variable	Mean (SD) / Range	*n*	Percentage
Time Prior to Treatment	3.1 days(7.4) / 0 -40 days	192	---

Time Prior to Treatment=Days between completion of baseline measures and chemotherapy infusion.

SD = standard deviation; ECOG = Eastern Cooperative Oncology Group.

Table 2

Characteristics of Study Variables

	Minimum	Maximum	Mean	SD
BAI	0	44	8.6	8.2
CES-D	0	48	12.1	10
SF-36				
Physical Component (PCS)	17	60	44.1	10.5
Mental Component (MCS)	13	67	49.2	11.1
Physical Functioning (PF)	5	100	67.6	26.9
Role-Physical (R-P)	0	100	54.4	44
Bodily Pain (BP)	12	100	72.2	24.8
Vitality (VT)	0	100	57.4	23.5
General Health (GH)	0	100	68	21.4
Social Functioning (SF)	0	100	75.3	26.8
Role-Emotional (R-E)	0	100	70.3	40
Mental Health (MH)	12	100	71.8	20
LSI				
METS	0	61	9.8	12.7
Exercise Group	**N**		**Percentage**	
None	63		32.8	
Mild	55		28.6	
Moderate or Strenuous	74		38.6	

SD = standard deviation; BAI = Beck Anxiety Inventory; CES-D = Center for Epidemiological Studies Depression Scale; SF-36 = Medical Outcomes Survey Short Form; LSI = Leisure Score Index; METS = weekly metabolic equivalent tasks (exercise activity) from LSI.

Table 3

Pearson Correlations of Demographic and Clinical Characteristics with Psychosocial and Exercise Variables

	Exercise Group	METS	BAI	CES-D	SF-36 PCS	SF-36 MCS
DEMOGRAPHIC VARIABLES						
Age (in years)	-0.04	0.01	-0.18 [a]	-0.13	-0.17 [a]	0.13
Gender (Female/Male)	0.01	0.06	0.1	-0.01	0.32 [b]	-0.08
Education (college degree/no)	0.08	0.1	-0.2	-0.05	0.09	0.03
Ethnicity (Hispanic/non-Hispanic)	0.04	-0.01	0.02	0.06	-0.04	-0.11
Race (White/Other)	-0.03	-0.01	-0.03	0.01	0.03	-0.04
Marital Status (Married/Unmarried)	-0.11	-0.12	-0.09	-0.1	-0.06	0.12
Body Mass Index (BMI)	-0.08	-0.1	0.14 [a]	0.17 [a]	-0.09	-0.11
CLINICAL VARIABLES						
Cancer Stage (I – IV)	-0.12	-0.09	-0.07	0	-0.20 [b]	-0.02
ECOG Status (0 -2)	-0.19 [b]	-0.18 [a]	-0.01	0.1	-0.17 [a]	-0.13
Time Prior To Treatment (days)	0.05	0.21 [b]	-0.03	0	0.02	0.07
Previously Received Chemotherapy (yes/no)	0	-0.03	0.03	0.03	-0.15 [a]	0.02
Recent Cancer Surgery (yes/no)	0.15 [a]	0.09	-0.06	0	0.04	0.04

METS = weekly metabolic equivalent tasks (exercise activity) from LSI; BAI = Beck Anxiety Inventory; CES-D = Center for Epidemiological Studies Depression Scale; SF-36 MCS = Short-Form 36 Mental Component Score; SF-36 PCS = Short-Form 36 Physical Component Score.

Note: Exercise group: higher scores= participation in higher level of exercise intensity in the past week. Participants designated into 3 groups based on highest level of exercise intensity endorsed on the LSI (none=no exercise, mild= mild exercise only, or moderate/strenuous=moderate or strenuous exercise).

[a] $P < 0.05$.

[b] $P < 0.01$.

Table 4

Correlations of Exercise (METS and 3 Groups) and Psychosocial Variables

	Exercise Group	METS
Anxiety (BAI)	-0.13	-0.19[b]
Depressive Symptoms (CES-D)	-0.15[a]	-0.18[a]
Quality of Life (SF-36)		
Mental Health (MCS)	0.18[a]	0.22[b]
Physical Health (PCS)	0.31[b]	0.35[b]
Physical Functioning (PF)	0.30[b]	0.31[b]
Role-Physical (R-P)	0.28[b]	0.33[b]
Bodily Pain (BP)	0.18[a]	0.29[b]
Vitality (VT)	0.34[b]	0.36[b]
General Health (GH)	0.18[a]	0.22[b]
Social Functioning (SF)	0.30[b]	0.31[b]
Role-Emotional (R-E)	0.15[a]	0.21[b]
Mental Health (MH)	0.15[a]	0.22[b]

METS = LSI weekly metabolic equivalent tasks (exercise activity); BAI = Beck Anxiety Inventory; CES-D = Center for Epidemiological Studies Depression Scale; For SF-36 scales: MCS = Mental Component Score; PCS = Physical Component Score.

Note: Exercise group: higher scores= participation in higher level of exercise intensity in the past week. Participants designated into 3 groups based on highest level of exercise intensity endorsed on the LSI (none=no exercise, mild= mild exercise only, or moderate/strenuous=moderate or strenuous exercise).

[a] $P < 0.05$.

[b] $P < 0.01$.

Table 5

Hierarchical Regression Analysis of METS to Anxiety

Variable		β	ΔR^2	Cumulative R^2	p^a
Step 1			0.05	0.05	0.01
	Age	-0.18			
	BMI	0.12			
Step 2			0.03	0.08	0.01
	METS	-0.18			

METS= weekly metabolic equivalents (continuous); BMI = body mass index.

[a] *P*-value for ΔR^2.

Table 6

Hierarchical Regression Analysis of METS and CES-D Depression Scores

	Variable	β	ΔR^2	Cumulative R^2	P^a
Step 1			0.03	0.03	0.02
	BMI	0.17			
Step 2			0.03	0.06	0.02
	METS	-0.16			

METS= weekly metabolic equivalents (continuous); BMI = body mass index.

[a] *P*-value for ΔR^2.

Table 7

Hierarchical Regression Analysis of SF-36 Physical Component Summary and METS

Variable		β	ΔR^2	Cumulative R^2	p^a
Step 1			0.13	0.13	< 0.001
	Gender	0.02			
	Age	-0.04			
	ECOG	-0.08			
	Stage	-0.06			
	Chemo	-0.1			
Step 2			0.10	0.23	< 0.001
	METS	0.33			

METS= weekly metabolic equivalents (continuous); BMI = body mass index; ECOG= Eastern Cooperative Oncology Group performance status; Chemo=previously received chemotherapy.

[a] *P*-value for ΔR^2.

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